QC METHODS

QC methods to check UV coated and/or naturally oiled (pre-finished) floors

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1. Adhesion

There are several procedures to check the adhesion between coating and substrate on the one hand and to check the adhesion between the different lacquer layers on the other hand.
Please find the three most common methods as follows:

a. Coin-test

The coin-test: you take a sharp edged coin between the forefinger and thumb, press firmly on the lacquer surface and pull with constant pressure across the film. In the case of bad adhesion between film and surface, the film will dissolve, scratches will occur and there will be a typical stress whitening. This procedure is the simplest method for checking the adhesion. The quality is based on a combination of variables (sharpness of edges, coin angle, coin diameter, applied pressure, etc.) and therefore only gives a rough indication, therefore this is not a norm-conform test.

Fig. 1: Surface before coin-test

Fig. 2: Surface with bad adhesion after coin-test

b. Hamberger Planer

Hamberger Industriewerke has developed a testing device called the “Hamberger Planer“ (Fig. 3) which can be used to conduct a “coin test” under defined conditions.

A piece of metal with a coin-like edge is pushed across the covered surface at a pre-definable pressure. The test result will be the maximum force to be applied until arriving at the appearance of first white marks. It is indicated/ expressed in Newton.

Any value above 20N could be considered as reasonable for the standard requirements of finished flooring.

Fig. 3: Hamberger Planer

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c. Cross-cut test according to DIN EN ISO 2409

The adhesive properties of the varnish film to the substrate and to itself is tested using a single or multiple blade cutter. As shown (Fig. 4), the blade is used to make a cross-cut on the test specimen offset by 90°. This produces a kind of chessboard pattern. The blades must cut through the varnish film. After cutting, any loose parts are removed from the surface with a brush. An initial inspection is carried out. Afterwards, an adhesion test is carried out with a defined adhesive tape. The tape is pressed onto the lattice with force before being pulled off at an even speed (between 0.5 – 1 second).

The surface is rated according to the following table:

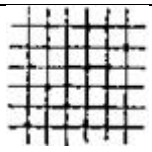
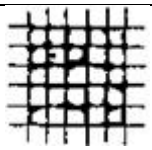
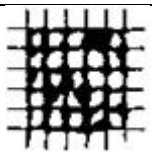
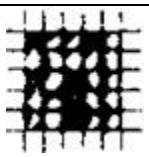
Grid Cut Classification	Description	Appearance of surface in area of grid-cut where flaking has occurred (example for six parallel cuts)
0	The edges of the cuts are completely smooth none of the lattice squares is detached.	-
1	Small flakes of coating have detached at the intersections of the cuts. The area affected is not significantly greater than 5% of the cross-cut area.	
2	The coating has flaked along the edges and/or the intersections of the cuts. Area of the cross-cut considerably greater than 5% but not significantly greater than 15% of the total cross-cut area.	
3	The coating has flaked along the edges of the cuts in wide strips partly/ completely and/or partial/complete flaking on some of the squares. A cross-cut area considerably greater than 15% but not significantly greater than 35% is affected.	
4	The coating has flaked along the edges of the cuts in wide strips and/or partial/ complete flaking on some of the squares. A cross-cut area considerably greater than 35% but not significantly greater than 65% is affected.	
5	Any flaking not classified by category 4.	-

Fig. 4: Multiple blade cutter

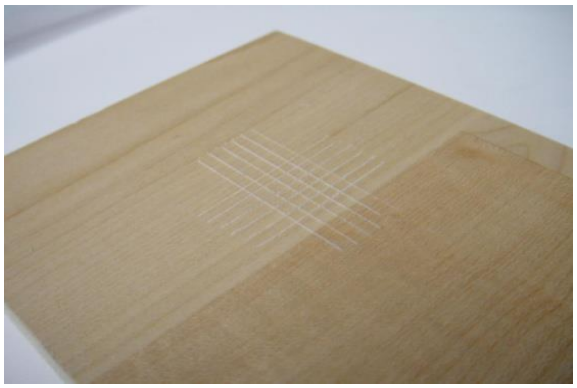


Fig. 5: Specimen with cross cut grid

2. Gloss value

According to ISO 2813, 60° geometry

Radiation from a light source is reflected by the surface at a defined angle (normally 60° for coated parquet surfaces) and the intensity of the reflected light is measured with a sensor. The more glossy the surface, the more light will be reflected by it and the higher the specular gloss. The gloss readings are too imprecise thus do not properly work out for very matt surfaces meaning that surfaces with identical gloss value may look considerably different. For the gloss level test it is therefore necessary to carry out a visual inspection of the test surfaces against a master sample. Therefore, measuring angles between 85° and 20° are used to more precisely determine the gloss level of high gloss and extreme matte surfaces. Any test report therefore needs to include information about the used measuring angle.

Fig. 6: Gloss level testing device

3. Color tones

Color variations should be checked against the master sample. For stains, transparent systems or metallic lacquer, the color tone depends on applied quantity, application method and substrate. Color variations may occur even if color quality remains constant. The master samples need to be stored under a cover to avoid color tone changes due to light exposure. Whilst producing master samples with transparent finishing, one section on the surface of the raw wood should be covered thus protected against the coating layers. This will allow to distinguish between changes of the wood color and of the coating itself at a later stage. Furthermore, the color should be checked using different kinds of light (day-, neon- and light bulb light). The approval of the current production sample should be carried out by two persons. In case you intend to coat larger surfaces such as front panels for furniture, we highly recommend to only use lacquer material of the same batch as a 100% color match from batch to batch is technically impossible.

4. Resistance to scratches / mar-resistance

Resistance to fine scratches is tested by rubbing on the surface with a piece of steel wool, applying normal pressure. As an alternative, an abrasive sponge could be used. Since there is no definition of test equipment so far, this kind of testing can only provide a rough indication.

Fig. 7: Surface scratches on a UV surface with normal UV top coat

Fig. 8: Grey marks on a surface with anti-scratch UV top coat

Fig. 9: No marks on a UV surface with UV anti-scratch top coat

5. Martindale test / gloss retention

According to DIN EN 16094

This European standard specifies a test method for the gloss retention applicable for all types of laminate floor coverings.

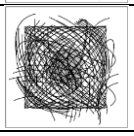
The sample is fixed on a horizontal table. A circular scrub material fixed on a holder impacts on the sample at a defined weight load. Table and holder are moved perpendicular against each other in a translational movement, at defined frequencies, tracing a Lissajous figure. The holder itself is freely rotatable around its own axis, perpendicular to the horizontal plate. The sample is exposed to the scrub material for a predetermined number of rubs. The visible changes of the surface are indicated by the subsequent visual assessment and an even more precise gloss measurement (as shown in #2).

Fig. 19: Martindale tester

There are two different procedures (A / B) to conduct the test. All the necessary parameters (scrub material, load, speed, number of cycles) are shown in the following table:

Test parameter	Procedure A	Procedure B
Scrub material	Very fine	Medium fine
Holder for scrub material	Version 2 (Sample holder plus heavy weight)	Version 1 (Sample holder plus light weight)
Number of rubs	80 rubs (= 5 Lissajous movements)	160 rubs (= 10 Lissajous movements)
Assessment	Gloss change	Visual according to Annex

Micro-scratch resistance class according to procedure A	Change of gloss
MSR-A1	≤10%
MSR-A2	> 10% to ≤ 30%
MSR-A3	> 30% to ≤ 50%
MSR-A4	> 50% to ≤ 70%
MSR-A5	> 70%

Microscratch resistance class according to procedure B	Scratch picture and description	
MSR-B1		No visible scratches
MSR-B2		Only a few hardly visible scratches
MSR-B3		Some easyly visible scratches
MSR-B4		A greater number of easyly visible raw and fine scratches, Lissajous figure partly visible
MSR-B5		Mix of Lissajous figure and a significant number of scratches, mat abrasion like area in the middle

6. Resistance to indentation

According to DIN EN 438 Part 2 – 25

The specimen is tested during one rotation of a defined diamond peak at a pre-defined load (Newton). Several scratch tests are carried out side by side at different levels of applied weight load thus pressure on the surface is changed on a scale from high to low. At higher weight loads, the surface will literally cut by the diamond needle. The test result is the value (expressed in Newton) at which an indentation of / cut on the surface is no longer visible.

Fig. 10: Testing device for measuring resistance to indentation

7. Impact test / ball-fall test

According to DIN EN 438 Part 2 – 12

After having set the spring's tension, a metal ball applies a defined force to the surface. The ball will produce a dent which is strongly depending on the hardness of wooden substrate itself. The test indicates the applied weight at which the first continuous cracks in the varnish appear in the form of concentric rings alongside the edge of the dent. These indentations are marked with a felt-tip pen before the ink is being wiped off with solvent (alcohol). This allows eventual cracks in the varnish to become better visible as the inks color in the crack will remain. This test is thus a method of measuring the elasticity of a varnish film. Due to the different levels of hardness of the wood itself, it is necessary to conduct testing on comparable (wooden) substrates.

The test result is the value in Newton at which no residue of pen color remains after having it wiped off with solvent.

Fig. 11: Impact test device

Fig. 12: Impact test device

8. Layer thickness

The thickness of the layer of the applied coating film could be measured with a (digital) microscope.

This method usually allows for a sufficiently precise reading in µm. There are also “non-destructive” test methods available in order to determine the thickness of the film layer. Practice however shows that the results from these tests can be extremely imprecise.

Fig. 13a: Analogue microscope

Fig. 13b: Digital USB-microscope

9. Heat resistance (cigarette test)

Corresponding to DIN 68861 Part 6

Three cigarettes of different brands are used for this test. The first 10mm of each cigarette have to be burnt before being applied onto the coated surface. The cigarettes are removed from the test surface once a cigarette has burned down further than 40mm.

In case any changes to the surface get visible, may it be in its color or other visible changes, the surface will need to be cleaned as thoroughly as possible with cleaning agent.

Classification of the test results:

6A No change
6B Change in gloss just gets visible to one’s eye
6C Gloss and/ or color change
6D Color change
6E Destroyed

Fig. 14: Cigarette test

10. Chemical resistance of surfaces coated with UV finishes

According to EN 13442

In the following table you will find a list of the chemicals used to indicate chemical resistance in accordance with EN 13442.

Our UV varnishes for prefinished parquet floors are meeting EN 13442 standard. Every chemical could be removed without a trace after being left on the surface for the defined duration.

Chemicals/ substances	Beginning temperature of substances (± 5) °C	Duration
Distillilled water	20	(24 ± 1) h
Cleaning agent (def. mixture)	20	(24 ± 1) h
Aceton, min. 95 %	20	(120 ± 10) s
Ethanol, clean, not denaturated, 50% in distilled water	20	(24 ± 1) h
Red wine, alcohol content 10% to 12% vol.	20	(24 ± 1) h
Red wine vinegar, acetic acid solution 3% to 5% vol.	20	(24 ± 1) h
Olive oil	20	(24 ± 1) h
Milk, 3% to 5% fat	80	(24 ± 1) h
Coffee, 40g instant coffee per l cooking water	80	(24 ± 1) h
Black tea, 10g tea leafs brewed with 1 l cooking water. Brewing time 5 min	80	(24 ± 1) h
Ammonia solution 10%	20	(8 ± 1) h
Blue/ black ink	20	(24 ± 1) h

Classification:

5: No visible changes (no damages).
4: Slight changes in gloss and color, only very hardly visible in certain angles when light sources are reflecting.
3: Slight marks, visible from different angles, for example the visibility of nearly complete form of filter paper.
2: Strong marks, but the structure of the surface is mostly unchanged.
1: Strong marks, the structure of surface has changed or the sealer is partially or even completely worn off, or the filter paper melts to the surface.

11. Chemical resistance of surfaces coated with oxidative drying oils

As there is no standard norm or test to specify the chemical resistance of surfaces treated with oxidative drying oils, we developed an internal test procedure especially for oxidative drying oils. Standard test methods (DIN 68861 and EN 13442) are not workable to highlight quality differences between different oxidative drying oil systems. We therefore included some parameters having significant impact, allowing to better differentiate the results. The roughness of the pre-sanding has a huge impact in terms of comparability of oiled surfaces. Thus we defined the wood sanding to be at a grit of 180.
Allow the oil to dry at room temperature for 36 hours after application before you start carrying out the test.

The following chart shows how to check such surfaces:

Chemicals/substances	Initial temperature of substances (± 5) °C	Duration
Distilled water	80	(16 ± 1) h
Coffee, 40g instant coffee per l cooking water	80	(16 ± 1) h
Black tea, 10g tea leafs brewed with 1 l cooking water. Brewing time 5 min	80	(16 ± 1) h
Coke	20	(16 ± 1) h
Black berry juice	20	(16 ± 1) h
Vinegar in water 2,5%	20	(16 ± 1) h
Mustard	20	(16 ± 1) h
Red wine, alcohol content 10% to 12% vol.	20	(16 ± 1) h
Acetic acid (4%)	20	1 h
Ethanol, clean, not denaturated, 50 % in distilled. water	20	1 h

Classification:

5: No visible change
4: Slight change of gloss and/ or color, only visible from certain viewing angles
3: Moderate change of gloss and/ or color
2: Marked change of gloss and/ or color
1: Surface distortion and/ or blistering

12. Abrasion resistance

For our abrasion resistance tests we use the so called Taber Abraser.

Fig. 15: Taber Abraser two-head unit

Fig. 16: The Taber Abraser in motion

a) Test according to DIN 68861 Part 2, S33 strips of sandpaper, 500g weight. Strips of sandpaper with defined grit are attached to the abrading wheels. The pressure applied to the test surface is 5.5 ± 0.2 Newton.

The strips are replaced every 500 revolutions. The test ends as soon as the first patch of wood becomes visible. This point is known as the “Initial Point” (“IP”).

b) Test according to ASTM D 4060, CS17 wheels, 1000g weight. Specially defined abrading wheels are used for this test. The test ends as soon as the first patch of wood becomes visible.

c) Test according to SIS 92 35 09, S39 with leather wheels and special sand S41 which is fed by an additional device, the 'grit feeder', at a weight of 1000g.

This test uses defined leather wheels together with a defined (quantity of) sand as abrasive medium. The grit feeder leaves a constant amount of the standard sand in front of the first leather wheel. The leather wheels move over the abrasive medium at a defined weight force of 1000g. Afterwards the sand is completely removed by vacuum suction, located after the second leather wheel. This ensures that the same amount of fresh sand will be applied to the specimen for every single revolution.

The test ends as soon as the first patch of wood becomes visible.

Fig. 17: Taber Abraser with falling sand grit feeder

13. Pendulum hardness test

According to ISO 1522

The test is conducted using a defined rounded steel top, which is placed on a glass plate based on the König test method which is used to measure the oscillation damping of the film of varnish. The number of oscillations is recorded by a photo sensor. The harder the coating film is, the higher the number of oscillations will be, as the pendulum will by nature be slowed down by a softer coating, leading to less swings.

Very hard UV varnishes may achieve more than 100 oscillations.

Fig. 18: Pendulum hardness tester

14. Water resistance

There are two different test methods which are established for testing laminate, printed direct laminate and also digital printed laminate. In the following, we introduce the two most commonly used test methods:

a) Water-bath at 23°C - 24 hours

This test method shows the adhesive properties of laminate, paper foil and coating build-up on HDF/ MDF substrates. The quality of the substrate has a high impact on the test results. Thus the swelling properties of the board could lead to a delamination of the subsequent surface build-up. A proper adhesion between substrate and melamine/ lacquer build-up is required to fulfill the test criteria.

Samples of a defined width of 5cm are fixed on a bar and will be put into the tempered water bath for 24 hours. The delamination is tested with and without a TESA-test after 2 hours of drying/ regeneration at room temperature.

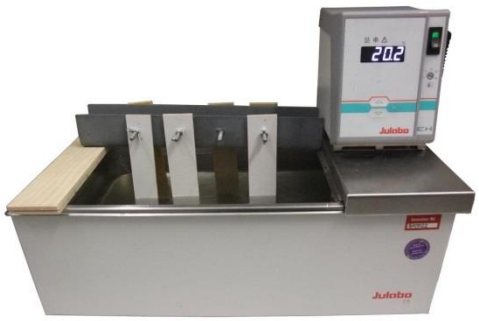


Fig. 20: Water-bath tempered

b) Hot water steam test at 100°C – 1 hour

This test method is tough test for the following three criteria: board swelling (quality of the substrate itself), delamination of the film/ foil and the steam resistance of the lacquer film. It is tested in accordance with DIN EN 438-2 chapter 14. Therefore, the specimen needs to be fixed upside down on top of the flask, weighed with a 500 gram weight. The coated side of the laminate needs to face the hot steam over the boiling water. To reach the maximum heat of 100°C of the water, we put some boiling stones into the water.

After regeneration time of 24 hours at room temperature the sample would be estimated without using any optical devices according to the following classification:

5: No visible change
4: Slight change of gloss and/ or color, only visible from certain viewing angles
3: Moderate change of gloss and/ or color
2: Marked change of gloss and/ or color
1: Blistering and/or delamination

Fig. 21: Hot vapor steam test